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2.10 Utility Conventions

2.10.1 Utility Argument Syntax

This subclause describes the argument syntax of the standard utilities and introduces terminology used throughout the standard for describing the arguments processed by the utilities.

Within the standard, a special notation is used for describing the syntax of a utility's arguments. Unless otherwise noted, all utility descriptions use this notation, which is illustrated by this example (see 3.9.1):

```
utility_name [-a][-b][-c option_argument ][-d | -e]
             [-f option_argument ][operand ...]
```

The notation used for the Synopsis subclauses imposes requirements on the implementors of the standard utilities and provides a simple reference for the reader of the standard.

(1) The utility in the example is named `utility_name`. It is followed by *options* , *option-arguments* , and *operands* . The arguments that consist of hyphens and single letters or digits, such as `-a`, are known as *options* (or, historically, *flags*). Certain options are followed by an *option-argument* , as shown with `[-c` *option_argument* `]`. The arguments following the last options and option-arguments are named *operands* .

(2) Option-arguments are sometimes shown separated from their options by `<blanks>`, sometimes directly adjacent. This reflects the situation that in some cases an option-argument is included within the same argument string as the option; in most cases it is the next argument. The Utility Syntax Guidelines in 2.10.2 require that the option be a separate argument from its option-argument, but there are some exceptions in this standard to ensure continued operation of historical applications:

(a) If the Synopsis of a standard utility shows a `<space>` between an option and option-argument (as with `[-c` *option_argument* `]` in the example), a conforming application shall use separate arguments for that option and its option-argument.

(b) If a `<space>` is not shown (as with `[-f` *option_argument* `]` in the example), a conforming application shall place an option and its option-argument directly adjacent in the same argument string, without intervening `<blank>`s.

(c) Notwithstanding the requirements on conforming applications, a conforming implementation shall permit, but shall not require, an application to specify options and option-arguments as separate arguments whether or not a `<space>` is shown on the synopsis line.

(d) A standard utility may also be implemented to operate correctly when the required separation into multiple arguments is violated by a nonconforming application.

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(3) Options are usually listed in alphabetical order unless this would make the utility description more confusing. There are no implied relationships between the options based upon the order in which they appear, unless otherwise stated in the Options subclause, or unless the exception in 2.10.2 guideline 11 applies. If an option that does not have option-arguments is repeated, the results are undefined, unless otherwise stated.

(4) Frequently, names of parameters that require substitution by actual values are shown with embedded underscores. Alternatively, parameters are shown as follows:

<parameter name>

The angle brackets are used for the symbolic grouping of a phrase representing a single parameter and shall never be included in data submitted to the utility.

(5) When a utility has only a few permissible options, they are sometimes shown individually, as in the example. Utilities with many flags generally show all of the individual flags (that do not take option-arguments) grouped, as in:

`utility_name [–abcDxyz][–p` *arg* `][`*operand* `]`

Utilities with very complex arguments may be shown as follows:

`utility_name [`*options* `][`*operands* `]`

(6) Unless otherwise specified, whenever an operand or option-argument is or contains a numeric value:

— the number shall be interpreted as a decimal integer.

— numerals in the range 0 to 2 147 483 647 shall be syntactically recognized as numeric values.

— When the utility description states that it accepts negative numbers as operands or option-arguments, numerals in the range –2 147 483 647 to 2 147 483 647 shall be syntactically recognized as numeric values.

This does not mean that all numbers within the allowable range are necessarily semantically correct. A standard utility that accepts an option-argument or operand that is to be interpreted as a number, and for which a range of values smaller than that shown above is permitted by this standard, describes that smaller range along with the description of the option-argument or operand. If an error is generated, the utility's diagnostic message shall indicate that the value is out of the supported range, not that it is syntactically incorrect.

(7) Arguments or option-arguments enclosed in the **[** and **]** notation are optional and can be omitted. The **[** and **]** symbols shall never be included in data submitted to the utility.

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(8) Arguments separated by the **|** vertical bar notation are mutually exclusive. The **|** symbols shall never be included in data submitted to the utility. Alternatively, mutually exclusive options and operands may be listed with multiple Synopsis lines. For example:

```
utility_name –d[–a][–c option_argument ][operand ...]
utility_name –e[–b][operand ...]
```

When multiple synopsis lines are given for a utility, that is an indication that the utility has mutually exclusive arguments. These mutually exclusive arguments alter the functionality of the utility so that only certain other arguments are valid in combination with one of the mutually exclusive arguments. Only one of the mutually exclusive arguments is allowed for invocation of the utility. Unless otherwise stated in an accompanying Options subclause, the relationships between arguments depicted in the Synopsis subclauses are mandatory requirements placed on conforming applications. The use of conflicting mutually exclusive arguments produces undefined results, unless a utility description specifies otherwise. When an option is shown without the **[ ]** brackets, it means that option is required for that version of the Synopsis. However, it is not required to be the first argument, as shown in the example above, unless otherwise stated.

(9) Ellipses (. . .) are used to denote that one or more occurrences of an option or operand are allowed. When an option or an operand followed by ellipses is enclosed in brackets, zero or more options or operands can be specified. The forms

```
utility_name –f option_argument ... [operand ...]
utility_name [–g option_argument ]... [operand ...]
```

indicate that multiple occurrences of the option and its option-argument preceding the ellipses are valid, with semantics as indicated in the Options subclause of the utility. (See also Guideline 11 in 2.10.2.) In the first example, each option-argument requires a preceding **–f** and at least one **–f** *option_argument* must be given.

(10) When the synopsis line is too long to be printed on a single line in this document, the indented lines following the initial line are continuation lines. An actual use of the command would appear on a single logical line.

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5098 **2.10.1.1 Utility Argument Syntax Rationale.** *(This subclause is not a part of P1003.2)*

5099 This is the subclause where the definitions of *option* , *option-argument* , and
5100 *operand* come together.

5101 The working group felt that recent trends toward diluting the Synopsis sub-
5102 clauses of historical manual pages to something like:

5103 `command [`*options*`] [`*operands*`]`

5104 were a disservice to the reader. Therefore, considerable effort was placed into
5105 rigorous definitions of all the command line arguments and their interrelation-
5106 ships. The relationships depicted in the Synopses are normative parts of this
5107 standard; this information is sometimes repeated in textual form, but that is only
5108 for clarity within context.

5109 The use of ‘‘undefined’’ for conflicting argument usage and for repeated usage of
5110 the same option is meant to prevent portable applications from using conflicting
5111 arguments or repeated options, unless specifically allowed, as is the case with `ls`
5112 (which allows simultaneous, repeated use of the `-C`, `-l`, and `-1` options). Many
5113 historical implementations will tolerate this usage, choosing either the first or the
5114 last applicable argument, and this tolerance can continue, but portable applica-
5115 tions cannot rely upon it. (Other implementations may choose to print usage mes-
5116 sages instead.)

5117 The use of ‘‘undefined’’ for conflicting argument usage also allows an implementa-
5118 tion to make reasonable extensions to utilities where the implementor considers
5119 mutually exclusive options according to POSIX. 2 to have a sensible meaning and
5120 result.

5121 POSIX. 2 does not define the result of a utility when an option-argument or
5122 operand is not followed by ellipses and the application specifies more than one of
5123 that option-argument or operand. This allows an implementation to define valid
5124 (although nonstandard) behavior for the utility when more than one such option
5125 or operand are specified.

5126 Allowing `<blank>`s after an option (i.e., placing an option and its option-
5127 argument into separate argument strings) when the standard does not require it
5128 encourages portability of users, while still preserving backward compatibility of
5129 scripts. Inserting `<blank>`s between the option and the option-argument is pre-
5130 ferred; however, historical usage has not been consistent in this area; therefore,
5131 `<blank>`s are required to be handled by all implementations, but implementa-
5132 tions are also allowed to handle the historical syntax. Another justification for
5133 selecting the multiple-argument method was that the single-argument case is
5134 inherently ambiguous when the option-argument can legitimately be a null
5135 string.

5136 Wording was also added to explicitly state that digits are permitted as operands
5137 and option-arguments. The lower and upper bounds for the values of the
5138 numbers used for operands and option-arguments were derived from the
5139 C Standard {7} values for {LONG_MIN} and {LONG_MAX}. The requirement on the
5140 standard utilities is that numbers in the specified range do not cause a syntax

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error although the specification of a number need not be semantically correct for a particular operand or option-argument of a utility. For example, the specification of `dd obs=3000000000` would yield undefined behavior for the application and would be a syntax error because the number 3 000 000 000 is outside of the range –2 147 483 647 to +2 147 483 647. On the other hand, `dd obs=2000000000` may cause some error, such as ‘‘blocksize too large,’’ rather than a syntax error.

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2.10.2 Utility Syntax Guidelines

The following guidelines are established for the naming of utilities and for the specification of options, option-arguments, and operands. Clause 7.5 describes a function that assists utilities in handling options and operands that conform to these guidelines.

Operands and option-arguments can contain characters not specified in 2.4.

The guidelines are intended to provide guidance to the authors of future utilities. Some of the standard utilities do not conform to all of these guidelines; in those cases, the Options subclauses describe the deviations.

Guideline 1: Utility names should be between two and nine characters, inclusive.

Guideline 2: Utility names should include lowercase letters (the `lower` character classification) from the set described in 2.4 and digits only.

Guideline 3: Each option name should be a single alphanumeric character (the `alnum` character classification) from the set described in 2.4. The `–W` (capital-W) option shall be reserved for vendor extensions.

NOTE: The other alphanumeric characters are subject to standardization in the future, based on historical usage. Implementors should be aware that future POSIX working groups may offer little sympathy to vendors with isolated extensions in conflict with future drafts.

Guideline 4: All options should be preceded by the `'–'` delimiter character.

Guideline 5: Options without option-arguments should be accepted when grouped behind one `'–'` delimiter.

Guideline 6: Each option and option-argument should be a separate argument, except as noted in 2.10.1, item (2).

Guideline 7: Option-arguments should not be optional.

Guideline 8: When multiple option-arguments are specified to follow a single option, they should be presented as a single argument, using commas within that argument or `<blank>`s within that argument to separate them. 2

Guideline 9: All options should precede operands on the command line.

Guideline 10: The argument `"––"` should be accepted as a delimiter indicating the end of options. Any following arguments should be treated as operands, even if they begin with the `'–'` character. The `"––"` argument should not be used as an option or as an operand.

Guideline 11: The order of different options relative to one another should not matter, unless the options are documented as mutually

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exclusive and such an option is documented to override any incompatible options preceding it. If an option that has option-arguments is repeated, the option and option-argument combinations should be interpreted in the order specified on the command line.

Guideline 12: The order of operands may matter and position-related interpretations should be determined on a utility-specific basis.

Guideline 13: For utilities that use operands to represent files to be opened for either reading or writing, the "−" operand should be used only to mean standard input (or standard output when it is clear from context that an output file is being specified).

Any utility claiming conformance to these guidelines shall conform completely to these guidelines, as if these guidelines contained the term ''shall'' instead of ''should,'' except that the utility is permitted to accept usage in violation of these guidelines for backward compatibility as long as the required form is also accepted.

Guidelines 1 and 2 are offered as guidance for locales using Latin alphabets. No recommendations are made by this standard concerning utility naming in other locales.

2.10.2.1 Utility Syntax Guidelines Rationale. *(This subclause is not a part of P1003.2)*

This subclause is based on the rules listed in the *SVID* . It was included for two reasons:

(1) The individual utility descriptions in Sections 4, 5, and 6, and Annexes A and C needed a set of common (although not universal) actions on which they could anchor their descriptions of option and operand syntax. Most of the standard utilities actually do use these guidelines, and many of their historical implementations use the *getopt* () function for their parsing. Therefore, it was simpler to cite the rules and merely identify exceptions.

(2) Writers of portable applications need suggested guidelines if the POSIX community is to avoid the chaos of historical UNIX system command syntax.

It is recommended that all *future* utilities and applications use these guidelines to enhance ''user portability.'' The fact that some historical utilities could not be changed (to avoid breaking existing applications) should not deter this future goal.

The voluntary nature of the guidelines is highlighted by repeated uses of the word *should* throughout. This usage should not be misinterpreted to imply that utilities that claim conformance in their Options subclauses do not always conform.

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Guideline 2 recommends the naming of utilities. In 3.9.1, it is further stated that a command used in the shell command language cannot be named with a trailing colon.

Guideline 3 was changed to allow alphanumeric characters (letters and digits) from the character set to allow compatibility with historical usage. Historical practice allows the use of digits wherever practical; and there are no portability issues that would prohibit the use of digits. In fact, from an internationalization viewpoint, digits (being nonlanguage dependent) are preferable over letters (a ''`-2`'' is intuitively self-explanatory to any user, while in the ''`-f` *filename* '' the letter `f` is a mnemonic aid only to speakers of Latin based languages where ''filename'' happens to translate to a word that begins with `f`. Since guideline 3 still retains the word ''single,'' multidigit options are not allowed. Instances of historical utilities that used them have been marked obsolescent in this standard, with the numbers being changed from option names to option-arguments.

It is difficult to come up with a satisfactory solution to the problem of namespace in option characters. When the POSIX.2 group desired to extend the historical `cc` utility to accept C Standard {7} programs, it found that all of the portable alphabet was already in use by various vendors. Thus, it had to devise a new name, `c89`, rather than something like `cc -X`. There were suggestions that implementors be restricted to providing extensions through various means (such as using a plus-sign as the option delimiter or using option characters outside the alphanumeric set) that would reserve all of the remaining alphanumeric characters for future POSIX standards. These approaches were resisted because they lacked the historical style of UNIX. Furthermore, if a vendor-provided option should become commonly used in the industry, it would be a candidate for standardization. It would be desireable to standardize such a feature using existing practice for the syntax (the semantics can be standardized with any syntax). This would not be possible if the syntax was one reserved for the vendor. However, since the standardization process may lead to minor changes in the semantics, it may prove to be better for a vendor to use a syntax that will not be affected by standardization. As a compromise, the following statements are made by the developers of POSIX.2:

— In future revisions to this standard, and in other POSIX standards, every attempt will be made to develop new utilities and features that conform to the Utility Syntax Guidelines.

— Future extensions and additions to POSIX standards will not use the `-W` (capital W) option. This option is forever reserved to implementors for extensions, in a manner reminiscent of the option's use in historical versions of the `cc` utility. The other alphanumeric characters are subject to standardization in the future, based on historical usage.

Implementors should be cognizant of these intentions and aware that future POSIX working groups will offer little sympathy to vendors with extensions in conflict with future drafts. In the first version of POSIX.2, vendors held a virtual veto power when conflicts arose with their extensions; in the future, POSIX working groups may be less concerned about preserving isolated extensions that conflict with these statements of intent.

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Guideline 8 includes the concept of comma-separated lists in a single argument. It is up to the utility to parse such a list itself because *getopt* () just returns the single string. This situation was retained so that certain historical utilities wouldn't violate the guidelines. Applications preparing for international use should be aware of an occasional problem with comma-separated lists: in some locales, the comma is used as the radix character. Thus, if an application is preparing operands for a utility that expects a comma-separated lists, it should avoid generating noninteger values through one of the means that is influenced by setting the **LC_NUMERIC** variable [such as `awk`, `bc`, `printf`, or *printf* ()].

Applications calling any utility with a first operand starting with `"-"` should usually specify `"--"`, as indicated by Guideline 10, to mark the end of the options. This is true even if the Synopsis in this standard does not specify any options; implementations may provide options as extensions to this standard. The standard utilities that do not support Guideline 10 indicate that fact in the Options subclause of the utility description.

Guideline 11 was modified to clarify that the order of different options should not matter relative to one another. However, the order of repeated options that also have option-arguments may be significant; therefore, such options are required to be interpreted in the order that they are specified. The `make` utility is an instance of a historical utility that uses repeated options in which the order is significant. Multiple files are specified by giving multiple instances of the `-f` option, for example:

```
make -f common_header -f specific_rules target
```

Guideline 13 does not imply that all of the standard utilities automatically accept the operand `"-"` to mean standard input or output, nor does it specify the actions of the utility upon encountering multiple `"-"` operands. It simply says that, by default, `"-"` operands shall not be used for other purposes in the file reading/writing [but not *stat* ()ing, *unlink* ()ing, `touch`ing, etc.] utilities. All information concerning actual treatment of the `"-"` operand is found in the individual utility clauses.

An area of concern that was expressed during the balloting process was that as implementations mature implementation-defined utilities and implementation-defined utility options will result. The notion was expressed that there needed to be a standard way, say an environment variable or some such mechanism, to identify implementation-defined utilities separately from standard utilities that may have the same name. It was decided that there already exist several ways of dealing with this situation and that it is outside of the scope of the standard to attempt to standardize in the area of nonstandard items. A method that exists on some historical implementations is the use of the so-called `/local/bin` or `/usr/local/bin` directory to separate local or additional copies or versions of utilities. Another method that is also used is to isolate utilities into completely separate domains. Still another method to ensure that the desired utility is being used is to request the utility by its full pathname. There are, to be sure, many approaches to this situation; the examples given above serve to illustrate that there is more than one.

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2.11 Utility Description Defaults

This clause describes all of the subclauses used within the utility clauses in Section 4 and the other sections that describe standard utilities. It describes:

(1) Intended usage of the subclause.

(2) Global defaults that affect all the standard utilities.

2.11.0.1 Utility Description Defaults Rationale.

(This subclause is not a part of P1003.2)

This clause is arranged with headings in the same order as all the utility descriptions. It is a collection of related and unrelated information concerning:

(1) The default actions of utilities.

(2) The meanings of notations used in the standard that are specific to individual utility subclauses.

Although this material may seem out of place in Section 2, it is important that this information appear before any of the utilities to be described later. Unfortunately, since the utilities are split into multiple major sections (chapters), this information could not be placed into any one of those sections without confusing cross references.

2.11.1 Synopsis

The Synopsis subclause summarizes the syntax of the calling sequence for the utility, including options, option-arguments, and operands. Standards for utility naming are described in 2.10.2; for describing the utility's arguments in 2.10.1.

2.11.2 Description

The Description subclause describes the actions of the utility. If the utility has a very complex set of subcommands or its own procedural language, an Extended Description subclause is also provided. Most explanations of optional functionality are omitted here, as they are usually explained in the Options subclause.

Some utilities in this standard are described in terms of equivalent POSIX.1 {8} functionality. As explained in 1.1, a fully conforming POSIX.1 {8} base is not a prerequisite for this standard. When specific functions are cited, the underlying operating system shall provide equivalent functionality and all side effects associated with successful execution of the function. The treatment of errors and intermediate results from the individual functions cited are generally not specified by this standard. See the utility's Exit Status and Consequences of Errors subclauses for all actions associated with errors encountered by the utility.

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